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Forestry

180 Canfield Street
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Date: February 17, 2000

Mr. Robert Wardwell
Adelphi Laboratory Center
2800 Powder Mill Road
Attn: AMSRL-OP-SO-FE (Wardwell)
Adelphi, MD 20783

Dear Mr. Wardwell:

Enclosed you will find the report on the Blossom Point Proving Grounds crop tree management mast monitoring project. The cooperative project between the US Army and the USDA Forest Service was established from August of 1998 to January, 1999. The main purpose of this mast monitoring project was to evaluate the effects of crop tree management on hard mast production. Mast will be monitored for 15 years.

As expected, mast production in the control area exceeded mast production in the crop tree area during the first year (1999) of the project. It is also expected that mast production in the crop tree area will increase significantly over the next several years.

I would like to thank you for your assistance to Rod Whiteman during this project. Other people who assisted Rod on this project included Karen Felton, Alan Iskra, Arlyn Perkey and Amy Onken. Everyone's contributions to this project were appreciated.

If you have any questions concerning this report or the crop tree management mast monitoring project, please contact Rod at (304) 285-1555.

Sincerely,


JOHN W. HAZEL
Field Representative
Morgantown Field Office

Enclosure

cc: Jack Keyser
James Mallow, MD State Forester
Gerry Hertel, Newtown Square

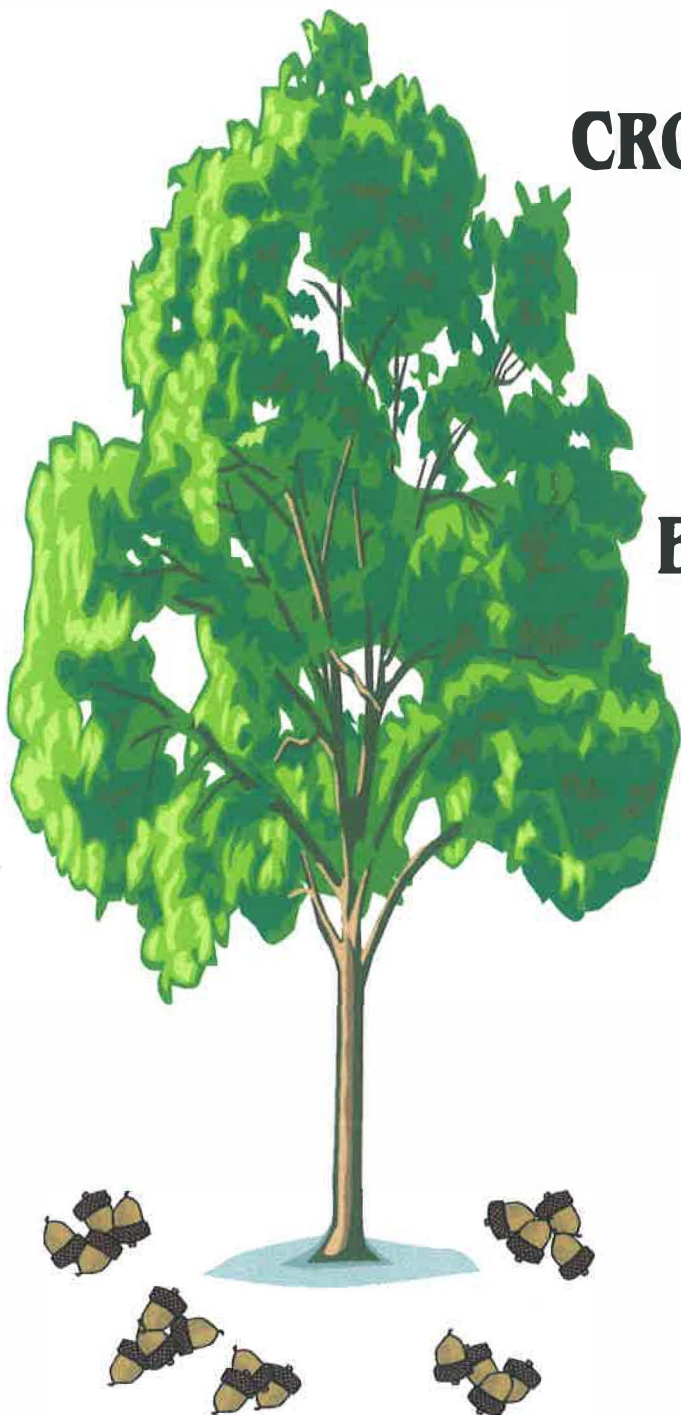
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CROP TREE MANAGEMENT AND MAST MONITORING At Blossom Point Proving Grounds



A cooperative project between the
USDA Forest Service and the US Army

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The first visit was made on September 28 and 29. Only 37 out of the 2049 (1.8%) acorns were viable. All 37 of these acorns were willow oak. Although viability of early dropped acorns is low, the 1.8% was surprisingly low. Weight of the viable willow oak acorns was 11.3 grams or .305 gram per acorn.

The second visit was on October 12 and 13. Out of the 2376 acorns, 14.6% or 347 acorns were viable. Three hundred and ten of the viable acorns were willow oak while 37 were southern red oak. Weight of the viable willow oak was 102.7 grams or .331 grams per acorns while the viable southern red oak acorns weighed 21.9 grams or .592 grams per acorn.

The third and final visit for 1999 was on October 26. Acorns from the crop tree area and the control areas were kept separate to see if there was a difference in viability between the crop tree area and the control area. Also the non-viable acorns were differentiated by species, counted and recorded in order to get a viability rate per species. Out of the total of 1728 acorns, 24.7 % or 428 acorns were viable. The difference in the viability rates between the crop tree area and the control area was minimal. Willow oak acorn viability in the crop tree area was 26.9 % compared to 21.7 % in the control area while southern red oak viability was 53.8 % in the crop tree area and 61.7 % in the control area. Although the viability of southern red oak acorns was a lot higher in both both areas than willow oak, far fewer acorns were produced. Between both areas during the last visit, 390 viable willow oak acorns were collected while viable southern red oak acorns totaled only 75. Both species of acorns were slightly larger in the control area than the crop tree area.

The amount (both number and weight) of viable mast per acre can now be calculated for both the crop tree area and control area. A total of 258 viable willow oak acorns and 18 southern red oak acorns were collected from the mast monitoring plots in the crop tree area. Multiplying 1932 (number of plots in crop tree area) by 6.3 (square feet per plot) by three (number of visits) and then dividing that total by 43560 (number of square feet per acre) will result in the number of .2794 (percent of an acre that was monitored in the crop tree area). Now dividing 258 and 18 by .2794, will result in figures of 923 viable willow oak acorns per acre and 64 viable southern red oak acorns per acre. Now multiplying 923 by .367 (average weight in grams of viable willow oak acorns) and 64 by .625 (average weight in grams of viable southern red oak acorns), will result in the weight of the mast on a per acre basis. In the crop tree management area in 1999, approximately 339.7g or .72lb of viable willow oak acorns per acre and 64.4 g or .13lb of viable southern red acorns per acre were produced.

The amount of viable mast produced in the control area can be calculated in a similar fashion. A total of 479 viable willow oak acorns and 57 viable southern red acorns were collected from the mast monitoring plots in the control area. Since there were a few more competing trees and thus mast monitoring plots in the control area, the percent of an acre that was monitored increased to .3002. Dividing 479 and 57 by .3002, will result in figures of 1596 viable willow oak acorns per acre and 190 viable southern red acorns per acre. These per acre figures were then multiplied by the the average weight for that respective species to determine the per acre weight of the viable mast. In the control area in 1999, approximately 585.7g or 1.24lb of viable willow oak acorns per acre and 118.8g or .25lb of viable southern red oak acorns per acre were produced.

Viable mast production in the control area exceeded production in the crop tree area by approximately 72 percent on willow oak and by 92 on southern red oak. It was expected that mast production in the control area would exceed production in the crop tree area during the early years of the mast monitoring. This was expected because there are now fewer mast producing trees in the crop tree area since some were cut as competing trees and crown expansion on these crop trees so far is minimal. It is anticipated that mast production in the crop tree management

area will increase significantly since the crowns of these crop trees have plenty of room to grow and should expand substantially. Time will tell if and when mast production in the crop tree area will exceed the production in the control area.

A secondary benefit of this crop tree area is that it provides growth response on willow oak and southern red oak, two species that have no crop tree history. The dbh of all the crop trees was measured during the second week of October. The dbh growth on the willow oak crop trees was the same as the controls (.33" vs .33") while growth on the southern red oak crop trees exceeded growth on the control trees by 23 percent (.32 vs .26). These two growth responses (0 and 23 percent, respectively) were the worst crop tree management growth responses ever recorded on any oak species. The results were very disappointing and were thought to have been greatly influenced by the extreme drought of 1999. It is anticipated that the response will be much greater in following years.

The foliar herbicide treatment will be applied in the summer of 2000, if necessary. Since the bulk of the stump sprouts should be dead from the 1999 herbicide treatment, most of the herbicide will need only to be applied to herbaceous material and newly established seedlings. This should decrease the amount of herbicide needed.

Mast monitoring in 2000, should follow the same schedule established in 1999. If mast viability of the first visit conducted during the last of September is extremely low (similar to 1999), this visit should be eliminated from the future schedule. Thus the mast monitoring would be conducted twice annually, the first visit during the second week of October and the second visit during the fourth week of October. Similar to the last visit of 1999, mast from the crop tree area and mast from the control area should be kept separate from one another for each visit. This will allow viability comparisons between the crop tree area and the control area. Also non-viable mast should be differentiated by species to get a viability comparison between southern red oak and willow oak.

The dbh of all crop trees should be measured annually every fall in order to make annual growth comparisons. These measurements should be made during one the mast monitoring visits in October.

Table 1--Total acorn production from the Blossom Point crop tree management area mast monitoring plots in 1999.

<u>Visit #</u>	<u>Dates</u>	<u>Total Acorns</u>	<u>Area</u>
1	9/28 and 29	539	Crop
		1510	Control
2	10/12 and 13	753	Crop
		1623	Control
3	10/26	567	Crop
		1161	Control

Table 2--Percent viability of acorn production from the Blossom Point crop tree management area mast monitoring plots in 1999

<u>Visit #</u>	<u>Viability</u>	<u>Species</u>	<u>Area</u>
1	1.8%	combined	combined
2	14.6%	combined	combined
3	26.9%	willow oak	crop
	53.8%	southern red oak	crop
	21.7%	willow oak	control
	61.7%	southern red oak	control

Table 3--Weight and number of viable acorns from the Blossom Point crop tree management area mast monitoring plots in 1999

<u>Visit #</u>	<u>Species</u>	<u># of Acorns</u>	<u>Weight of Acorns (g)</u>	<u>Weight per Acorn (g)</u>	<u>Area</u>
1	willow oak	37	11.3	.305	combined
2	willow oak	310	102.7	.331	combined
	southern red oak	37	21.9	.592	combined
3	willow oak	149	57.4	.385	crop
	southern red oak	7	4.2	.600	control
	willow oak	241	99.4	.413	crop
	southern red oak	31	20.8	.671	control

This report summarizes the work and first year results at the Blossom Point Proving Grounds crop tree management area. The primary purpose of this crop tree area was to evaluate the effects of crop tree management on mast production. Mast production will be monitored over a 15 year period.

In August of 1998, USDA Forest Service personnel initiated a crop tree management area at Blossom Point Proving Grounds. Crop tree management is a fairly new silvicultural technique that concentrates and accelerates growth on the better quality trees in a stand by releasing them from nearby competing trees. Based on data from twelve crop tree areas located in four states, diameter breast height (dbh) has been accelerated 50 to 100 percent on species such as red oak, black oak and yellow poplar. Accelerated crown growth has also been documented. The primary purpose of this crop tree management area was to monitor the effects on hard mast production.

Hard mast production is critical for many species of wildlife including deer, bear, turkey and squirrel. When available, hard mast is a major food source for these animals during the fall and winter months. Hard mast comes in the form of acorns, walnuts, hickory nuts and beech nuts. Out of all of these, acorns are usually the most abundant, widely distributed and most important type of hard mast. At a given dbh, mast production is much greater on a tree with a large crown than one with a small crown. Stimulating the crown growth on a mast producing tree will increase the mast production on that individual tree. The results obtained from the monitoring of mast production may show that crop tree management is another tool that wildlife biologists and managers can use to improve wildlife habitat.

Blossom Point Proving Grounds is a 1,600 acre DOD facility located on Maryland's coastal physiological province approximately 35 miles south of Washington, DC., near the town of La Plata (Figure 1). Oak-hickory and oak-gum-cypress forest types are dominant at this facility. A variety of oak species comprise the vast majority of the hard mast producers located at this site.

Criteria established for the crop tree management area was that hard mast producers must comprise at least 25 percent of the basal area and most of the hard mast producers must be between 10-24" dbh. Generally speaking, significant mast production starts when a mast producing tree reaches 10 inches and will decline after a tree reaches a dbh in the mid-twenties. After looking at several sites, an area was selected (Figure 2). Based on data from six 10-BAF plots, oaks comprised 45 percent of the basal area in this stand. No other hard mast producers were present. Sweet gum (34%), Virginia pine (11%) and red maple (10%) comprised the rest of the stand. Other than oak species, hard mast producers are very limited at this facility. Walnut, hickory and beech comprise less than one percent of the basal area of the entire site. In the crop tree management area, willow oak comprised 51 percent of the oak species while southern red oak comprised the rest of the oak component. Basal area is approximately 122 square feet per acre while the average dbh is approximately 10.1 inches. Oak dbh is approximately 12.0 inches.

A two acre block was then established, flagged and boundaries marked with paint. This two acre block would serve as the actual crop tree management block. The area adjacent to this block would serve as the control block (Figure 2). Everything would be done similar in this block as in the crop tree management block except these "control" crop trees would not be released.

Crop trees were then selected, marked with paint at dbh and numbered and with paint in both the crop tree and the control blocks. Twelve willow oaks and twelve southern red oaks were selected in both blocks. All the crop trees were hard mast producers, had healthy crowns which showed no signs of upper crown dieback and showed no imminent signs of decline. The dbh of

all the crop trees were measured and recorded. Crop trees ranged in size from 9 to 29", with the vast majority between 12 to 24". The willow oak and southern red oak crop trees averaged 16.1" and 16.0" dbh, respectively, while the willow oak and southern red oak control crop trees averaged 15.9" and 16.8" dbh respectively. Another benefit of this crop tree management area is that it will provide dbh growth responses on southern red oak, and willow oak, two species that currently have no crop tree management history. The radius of the crown of each crop tree was then measured and recorded for all four cardinal directions.

At each of the 48 crop trees, all competing trees were identified and marked with paint. A competing tree is one whose crown touches the crown of a crop tree. The distance and direction from each of the competing trees to the crop tree was measured and recorded along with the competing tree's species and dbh. Similar to the crop trees, the radius of the competing tree's crown was measured and recorded in each of the four cardinal directions.

It was then time to release the crop tree in the crop tree management block. This can be done by girdling the competing trees, felling the competing trees, or a combination of both felling and girdling. In this crop tree management area, felling was the preferred method of release. Although girdling does promote dead standing woody habitat which is beneficial to some birds and mammals, it can be extremely hazardous when the decaying trees start falling. To reduce the risk of being struck by a branch or tree while counting mast production, it was decided to fell as many of the competing trees as possible. Out of the 137 competing trees in the crop tree management area, only 2 were not felled. These two trees were girdled and left standing because they were likely to damage crop trees if felled. The demise of these two trees will take place over a number of years starting with the bark sloughing off and small branches falling off and eventually the large branches and finally the bole falling. Damage to the crop trees by this process will be very unlikely.

It was then time for placement of the stakes that would serve as the center of the mast monitoring plots. In each of the four cardinal directions at every crop tree and competing tree, painted bamboo stakes approximately 16" long were placed in the ground 2/3 of the way from the bole of the tree to the edge of the crown. Likewise, stakes were placed under the cut competing trees based on previously recorded measurements. Each mast monitoring plot would cover approximately 6.3 square feet and have a radius of 17 inches.

In order to get an accurate assessment of the mast production, it was decided to move the woody debris at least four feet away from the plot center (2 1/2 feet away from the edge of the plot). With 135 freshly cut competing trees in the crop tree management block, most of the plots were covered by tree boles and limbs. These down competing trees were bucked into moveable pieces and piled where they would not interfere with the mast monitoring plots. Although no standing trees were cut in the control block, downed limbs and logs near and inside the mast monitoring plots were cut and moved away from the plots. The removal of the woody debris should significantly reduce the occurrence of mast falling inside the plot, hitting a hard object and bouncing off the plot. Conversely, it should also reduce the chance of mast falling outside the plots and bouncing inside them. By January 29, 1999, the crop tree management area was fully established.

A foliar herbicide such as Roundup® will be applied to the mast monitoring plots when necessary on regeneration or herbaceous growth. This will allow for a more accurate and timely counting of the mast production. Without the use of a herbicide, regeneration and/or herbaceous growth is likely to become extremely thick and an accurate assessment of the mast production would be virtually impossible. The herbicide will not be applied on the entire area. It will be applied only within four feet of a mast monitoring plot center. Since the overstory canopy was not disturbed in the control area, use of herbicide is not anticipated in this area.

The dbh of all the crop trees will be measured annually in the fall. This will allow a comparison of growth rates between the crop trees in the crop tree management area and the control area. This will provide the first crop tree growth data on both willow oak and southern red oak.

Due to the large variation in annual mast crop production and to allow time for the crowns of the released crop trees to expand, these mast production plots need to be monitored for 15 years. Since these plots are not protected from birds and mammals, mast predation may be a problem. In order to reduce the impacts of this potential problem, the mast production plots will be visited three times every fall on a bi-weekly basis. The first visit should be during the last week of September, the second during the second week of October and the last visit during the fourth week of October. Not only will this schedule reduce predation problems, it will also allow the completion of the monitoring each year prior to leaf drop. If leaf drop occurred prior to the last visit, monitoring accuracy would be significantly reduced since the leaves would be covering some of the mast. During each visit, mast will be counted, collected and recorded for each monitoring plot. Since wildlife species can sense acorn viability and will usually feed only on viable mast, viability of the mast needs to be determined. The collected mast will then be brought back to the Forest Service Laboratory in Morgantown to determine viability.

Viability will be determined using the float test method. The float test method is a quick and easy way to get an accurate estimate on acorn viability. Acorns will be placed in a bucket of water and the viable ones will sink and the non-viable ones will float. Viable mast will then be room dried for at least two months, cleaned (caps removed), differentiated by species, weighed and recorded. The total amount (weight and number) of viable mast will then be calculated for the crop tree area and the control area. Also, viable mast can be calculated for individual crop trees in both areas.

At this point the comparison between the crop trees and control trees can take place. Releasing the 16 inch dbh southern red oak that is completely surrounded by sweet gum and Virginia pine will definitely increase mast production. The difficult and to this date unanswered question is one large crowned mast producer better than two mast producers with medium sized crowns? Is one large crown better than three small crowns? Hopefully these questions will be answered.

It has been shown that crop tree management can be a valuable tool to a forester in producing larger volumes of high quality timber products. In time, the crop tree management area at Blossom Point Proving Grounds will show if it will be a valuable tool for resource managers and wildlife biologists to improve wildlife habitat.

The initial work at the Blossom Point Proving Grounds crop tree management area was now complete. On going work will include herbicide treatments, mast monitoring and analysis, and dbh monitoring and analysis.

On August 3, 1999, Roundup® was applied using a backpack sprayer to the regeneration and herbaceous material in and near the mast monitoring plots in the crop tree area. The bulk of the herbicide application was on stump sprouts from the cut competing trees. Seedlings and herbaceous material were also treated. As anticipated, herbicide treatment in the control area was not necessary.

The results of the mast monitoring from 1999 are presented in Tables 1-3. A brief summary of each visit follows.